Contribution ID: **7** Type: **not specified**

Effective Field Theory for Extreme Mass Ratios (Part 1)

Monday 11 December 2023 14:30 (30 minutes)

The metric and corresponding geodesic equation describing test-particle dynamics in a background encode gravitational data to all orders in the post-Minkowskian (PM) expansion and effectively resum certain infinite classes of flat-space Feynman diagrams. In the context of the connection between the bound gravitational two-body problem and the relativistic scattering of massive particles interacting via gravity, I will describe how this property can be leveraged to obtain information about post-Minkowskian conservative dynamics as a systematic expansion in the mass ratio of the interacting bodies, also known as the self-force (SF) expansion. At the leading PM order for arbitrary mass ratios and all PM orders in the test-particle limit, data such as isotropic gauge Hamiltonians and scattering amplitudes can be algebraically extracted for a non-spinning black hole binary system and small perturbations away from it. Higher SF dynamics can be determined using an effective field theory (EFT) setup that accounts for the recoil of the heavy body due to effects from the light body through "recoil operators". This EFT formalism for extreme mass ratios will be discussed.

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Session Classification: Monday PM 1